Evaluation of a 3D surface imaging system for patient positioning and intra-fraction monitoring

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Differences between DIR and the rigid algorithm were only found to be statistically significant for roll (p=0.01). Independently of the reference image used, the results showed less accurate OS positioning for the deeper target (n° 4) (Fig. 2 c, d).

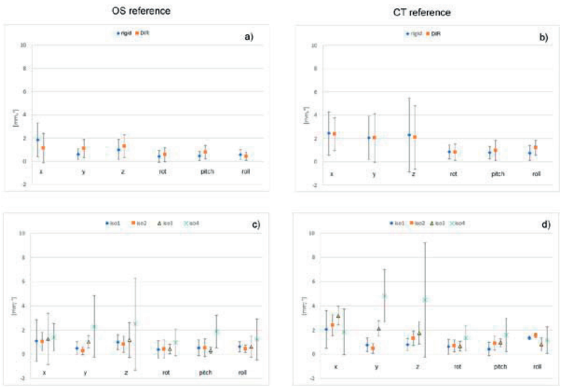

Fig.2 Mean absolute differences (for all targets and deformations) between Catalyst™ and CBCT registration results using OS a) and CT b) as reference. Mean absolute differences between Catalyst™ and CBCT for each target using DIR and OS c) and CT d) as reference.

Conclusion

Overall, the smallest differences compared to CBCT were found when Catalyst™ used OS as reference to position the deformed phantom.

No benefit in the use of DIR algorithm appeared. Using CT as reference were found to be less accurate, hence, showing a limited applicability of this option. The depth of the target inside the phantom affected the registration accuracy.

PO-0938 Evaluation of a 3D surface imaging system for patient positioning and intra-fraction monitoring

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Purpose or Objective

The objective of this study was to evaluate the accuracy of a 3-dimensional surface imaging system (AlignRT) for patient positioning and intra-fraction monitoring during deep-inspiration breath-hold (BH) and free breathing (FB) radiotherapy treatments in thoracic and pelvic tumours.

Material and Methods

The patient cohort was composed of 18 breast cancer (12 BH, 6 FB), 7 thoracic cancer (FB) and 2 pelvic (FB) cancer patients. AlignRT data were prospectively collected during CBCT acquisition and during treatment. On average 9 treatment fractions per patient were monitored. In all patients CBCT's were acquired for position verification prior to irradiation. The monitoring area for AlignRT consisted of the patient's surface closest to the target volume. Position errors of both the patient surface and the target volume with respect to the planning CT were determined from the CBCT and compared with AlignRT data on the position errors of the patient surface. The differences between the CBCT and AlignRT position errors were determined as well as the correlation between the CBCT (surface and target volume) and the AlignRT surface position errors. Furthermore, BHs were analysed for intra-fraction reproducibility and stability. The reproducibility was determined by comparing the plateau regions of the BHs, whereas the stability was determined by calculating the height difference of the start- and endpoint of the BH.

Results

Figure 1 shows the differences between the position errors from AlignRT and from the CBCT's matched on patient surface and on target volume. The differences are smallest in the breast BH patients matched on patient surface (max mean difference of 0.39 ± 2.31 (1SD) mm in the RL and CC direction). In comparison, the breast BH patients matched on the target volume resulted in a max mean difference of 1.77 ± 2.56 mm (AP direction). For the thoracic patients, the max mean difference was -2.48 ± 2.39 mm (CC direction) based on the patient surface matches and was -1.83 ± 2.76 mm (CC direction) on the target volume matches. The standard deviation in the CC direction for the pelvic tumour was nearly twice as high compared to the other groups. Figure 2 shows the scatter plots between the CBCT (surface and target volume) matches and the AlignRT matches for the breast patients with the correlation factors. Interestingly, the overall correlation was highest in the thoracic tumour patient group (average R^2 = 0.72 surface and average R^2=0.54 target volume). The correlation in the CC direction was almost zero for the prostate patients. The intra-fraction BH reproducibility for the breast patients was on average within 0.9-1.5 mm, whereas the BH stability was on average within 1.0-1.9 mm.

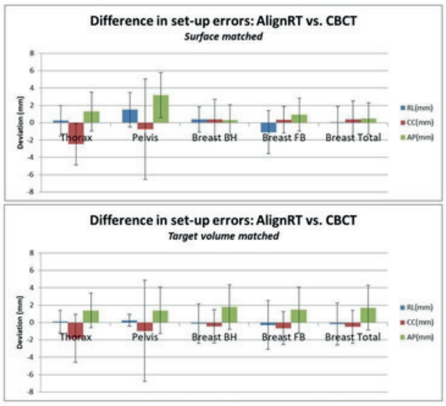

Figure 1: The mean differences in set-up errors between AlignRT and the CBCT (surface and target volume matched) for the different patient groups. The error bars presented are ±1SD.

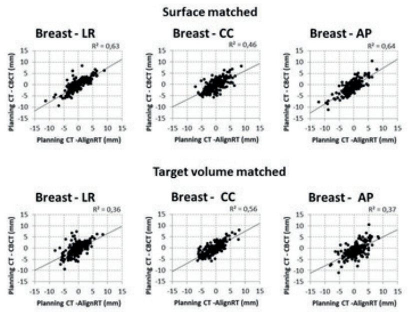

Figure 2: Scatterplots from the CBCT (surface and target volume) matched errors vs. AlignRT surface errors for the breast patients. The correlation factor is represented by the R^2 value above the graph.

Conclusion

With AlignRT the patient surface of breast cancer patients can be positioned and monitored with high accuracy (0.39 ± 2.31 (1SD) mm) based on comparison with CBCT data. The positioning accuracy of the target volume is worse but still within 1.83 ± 2.76 mm for breast (BH and FB) and thorax patients.